[useAMS,usenatbib]mn2e

graphicx

Hα

^{o}

μm μK Q_{rms-PS} n c_{DMR} c_ν T_e f_d

footnote

document

[Reappraising the *COBE*-DMR data]Reappraising foreground contamination in the *COBE*-DMR data

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abstract

With the advent of all-sky surveys it is possible to determine a reliable free-free template of the diffuse interstellar medium (Dickinson, Davies & Davis 2003) which can be used in conjunction with the synchrotron and dust templates to correct CMB observations for diffuse Galactic foregrounds. We have used the *COBE*-DMR data at 31.5, 53 and 90 GHz and employed cross-correlation techniques to re-evaluate the foreground contributions, particularly that due to dust which is known to be partially correlated with (and free-free) emission.

The DMR microwave maps are found to contain, as well as the expected synchrotron and free-free components, a component tightly correlated to the 140 dust maps of DIRBE. At 31.5, 53 and 90 GHz this emission is 6.3 ± 0.6, 2.4 ± 0.4 and 2.2 ± 0.4 /(MJy sr^{-1}) at 140 respectively. When corrected for the contribution from thermal dust following model 7 of Finkbeiner, Davis & Schlegel (1999), a strong anomalous dust-correlated emission component remains, which is well-fitted by a frequency spectrum of the form $\nu^{-\beta}$ where β ~ 2.5 in the DMR frequency range; this is the dominant foreground at 31.5 GHz. The result implies the presence of an emission component with a dust-like morphology but a synchrotron-like spectrum. We discuss the possible origins of this component and compare it with the recent *WMAP* interpretation.

The better knowledge of the individual foregrounds provided by the present study enables a larger area of the sky ($|b| > 15$) to be used to re-appraise the CMB quadrupole normalisation, , and the scalar perturbations spectral index, n. We find $= 15.2^{+2.8}_{-2.3}$ with a power-law spectral index of $n = 1.2 \pm 0.2$. These values are consistent with previous *COBE*-DMR analyses and the *WMAP* 1-year analysis.

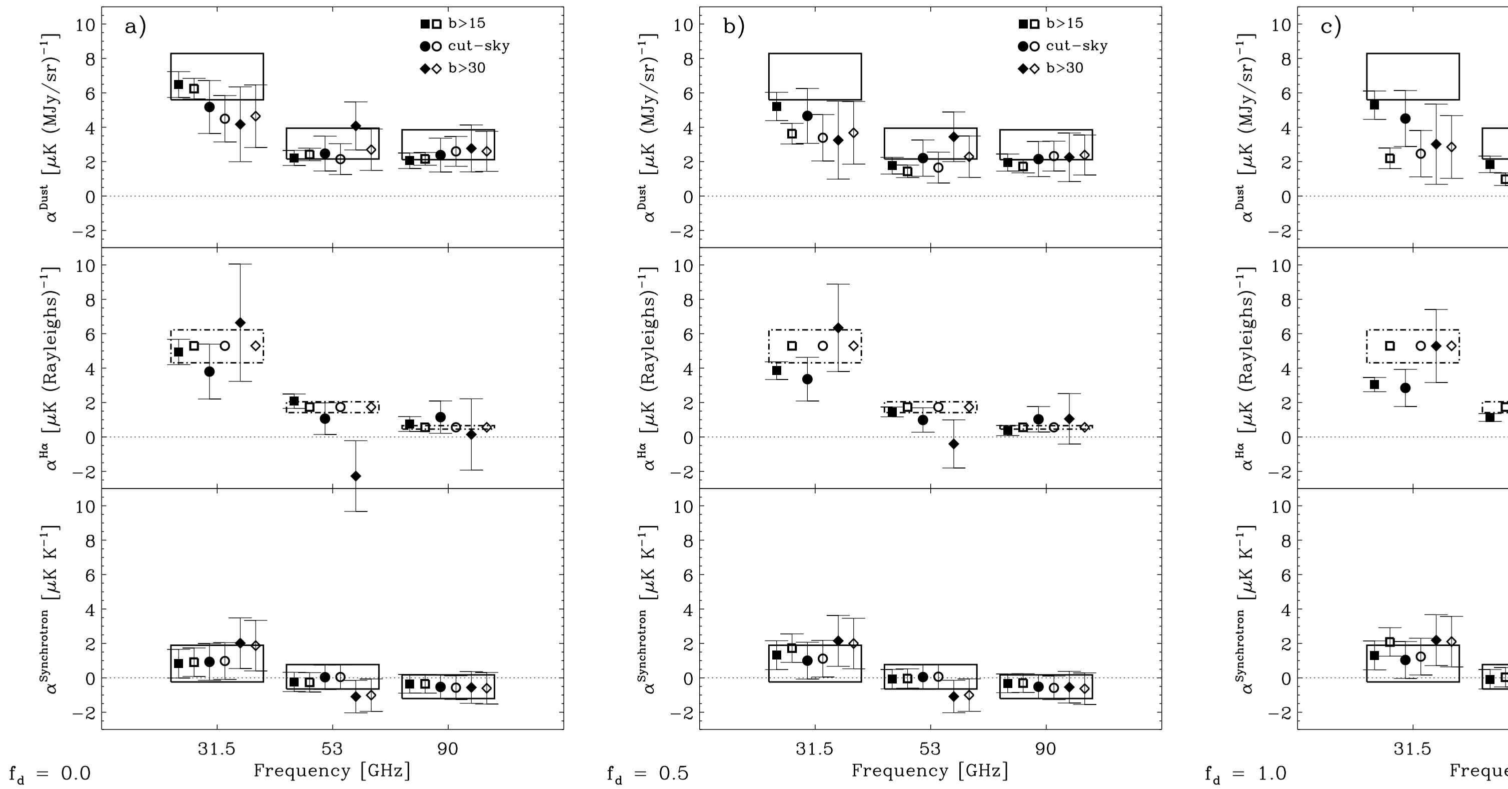
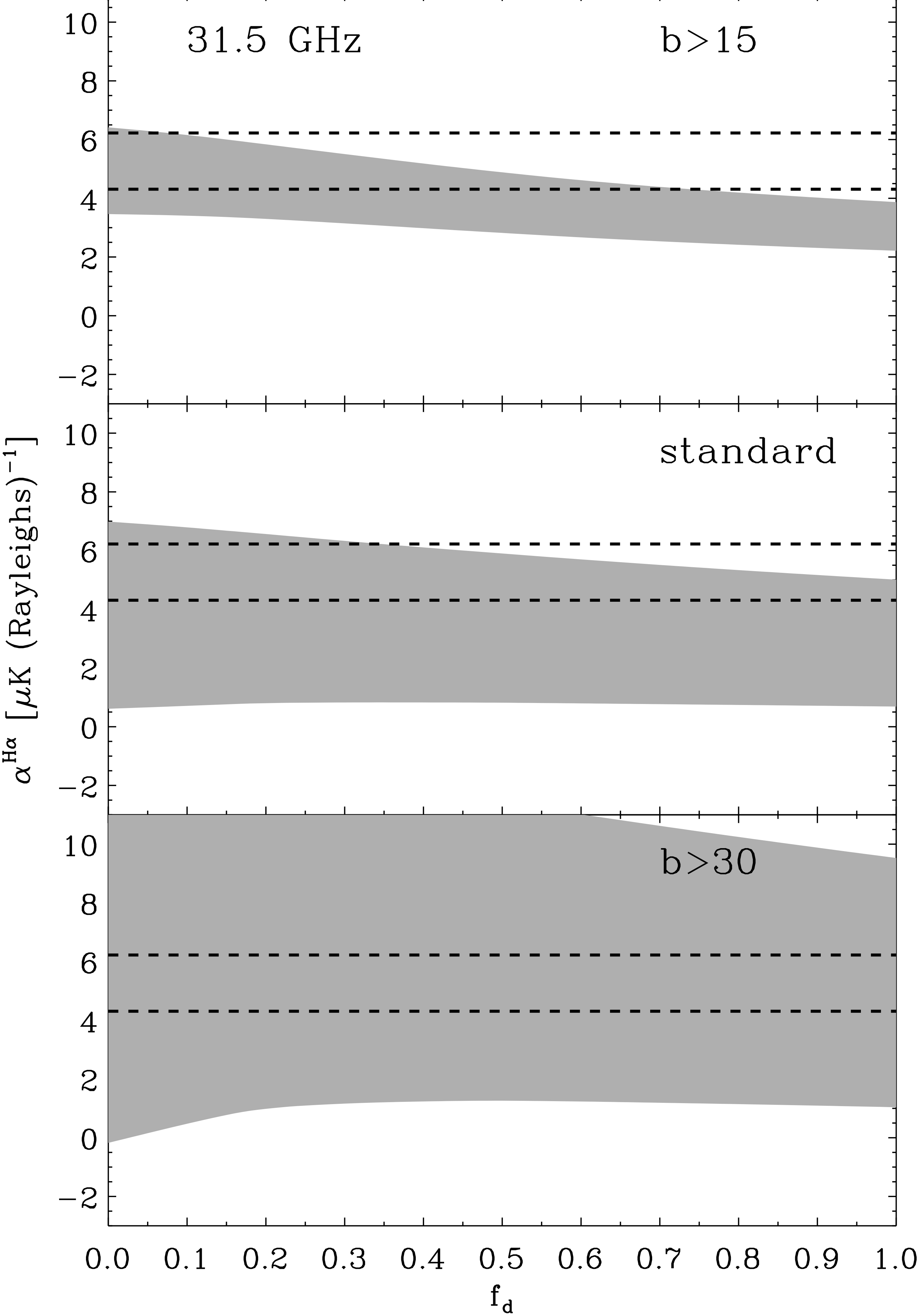
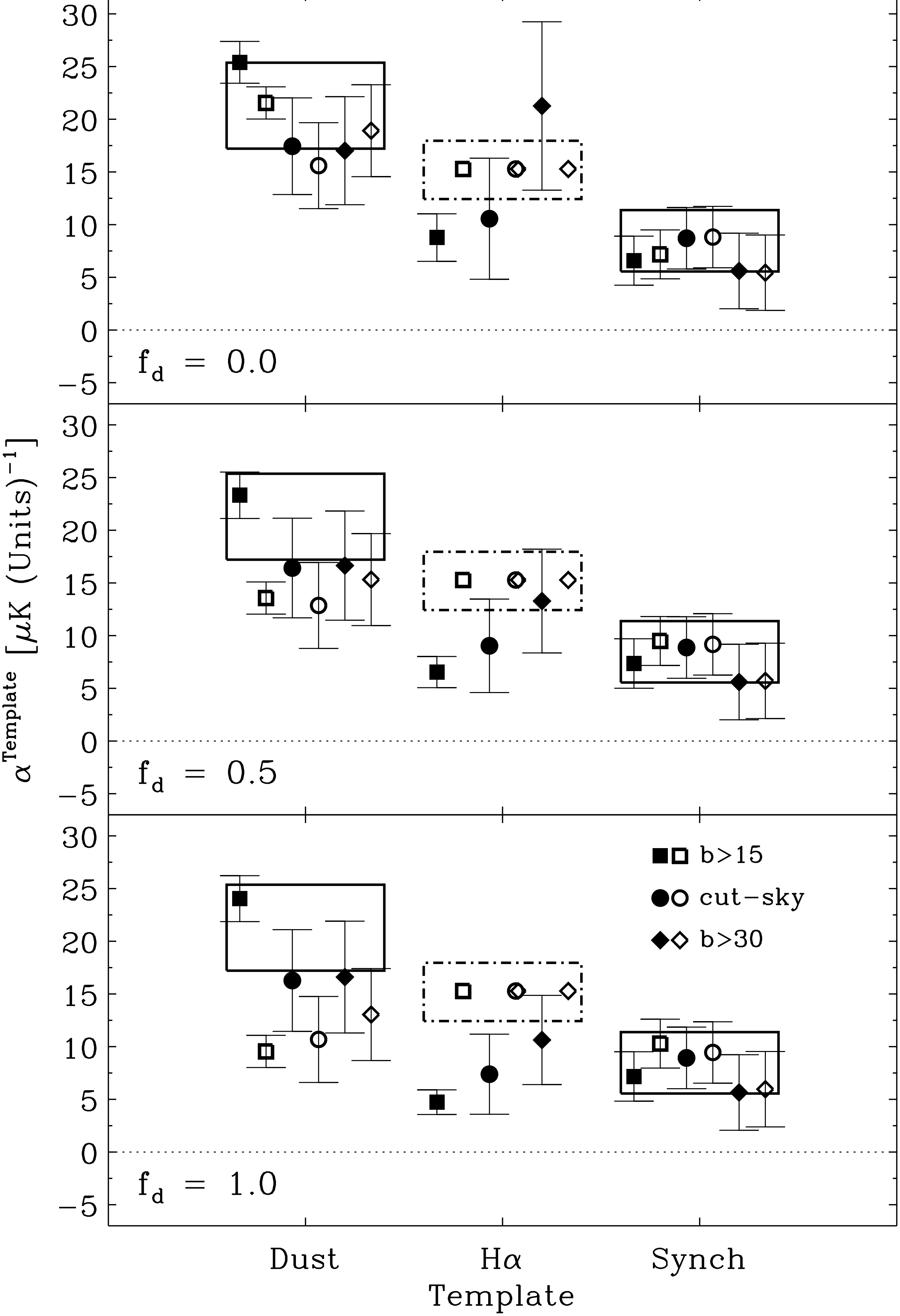
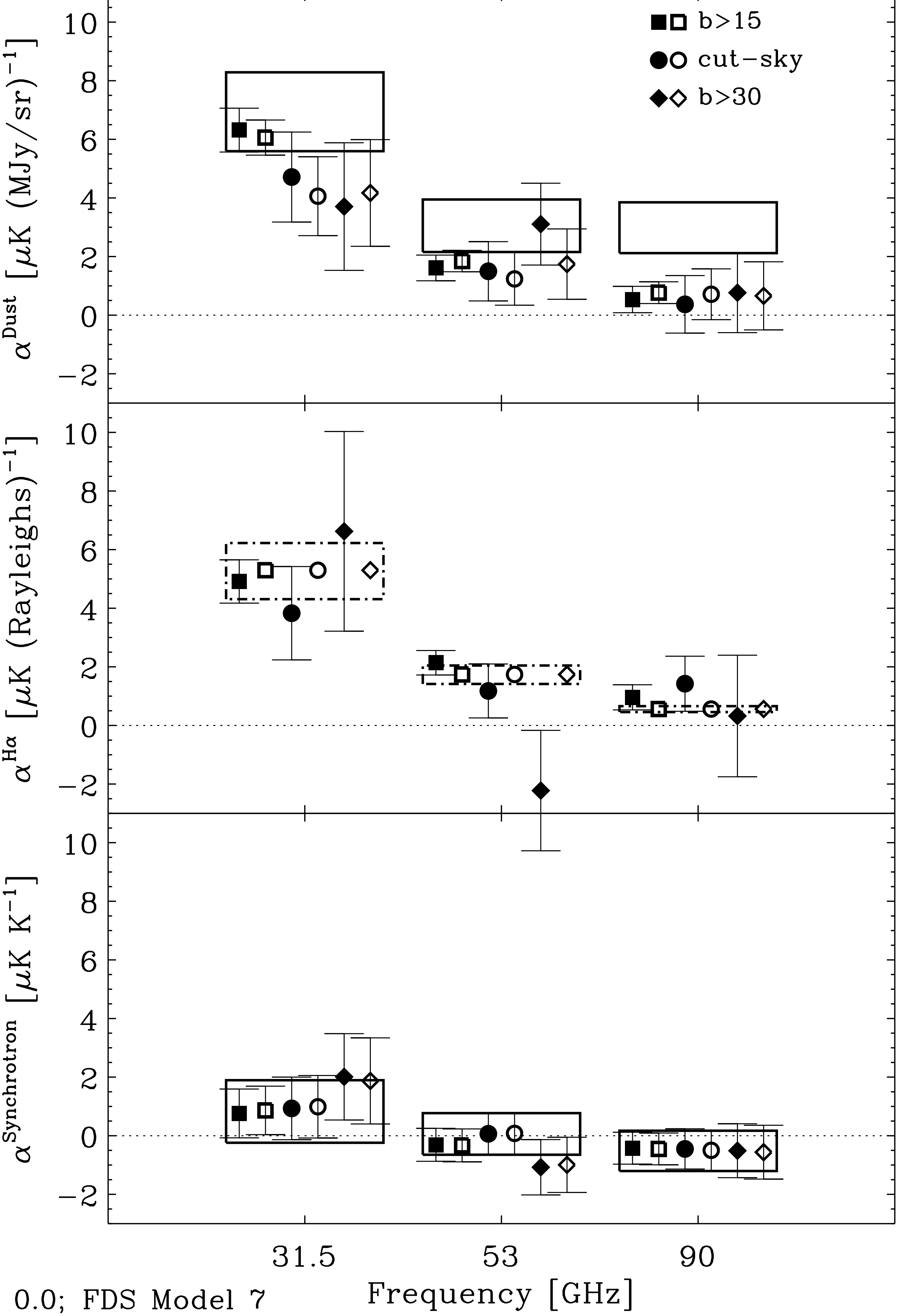


Figure 1. Derived coupling coefficients between the DMR data at 31.5, 53 and 90 GHz and three templates for foreground emission: dust is traced by
(*top* panels), free-free emission by Hα data (*middle* panels), and synchrotron emission by a sky map at 408 MHz (*bottom* panels). Coefficients are comp
$|b| > 15°$ (squares), the standard Galactic cut (circles) from Banday et al. (1997) and $|b| > 30°$ (diamonds). The filled symbols correspond to fits made be
three templates simultaneously, while open symbols are fits made to the dust and synchrotron tracer maps *after* correcting the DMR data by the free-f
Hα template according to the scalings in Dickinson et al. (2003). In the upper and lower panels, the closed boxes show results consistent with previous
the DIRBE and Haslam templates and the standard Galactic cut. In the middle panel the dashed boxes show the coupling coefficient amplitudes predict
for the Hα -correlated free-free emission assuming values for the electron temperature between 5000 K and 9000 K (the lower and upper bounds respectiv
three assumed values (0,0.5 and 1.0) of the dust absorption parameter f_d (see section 2.2).

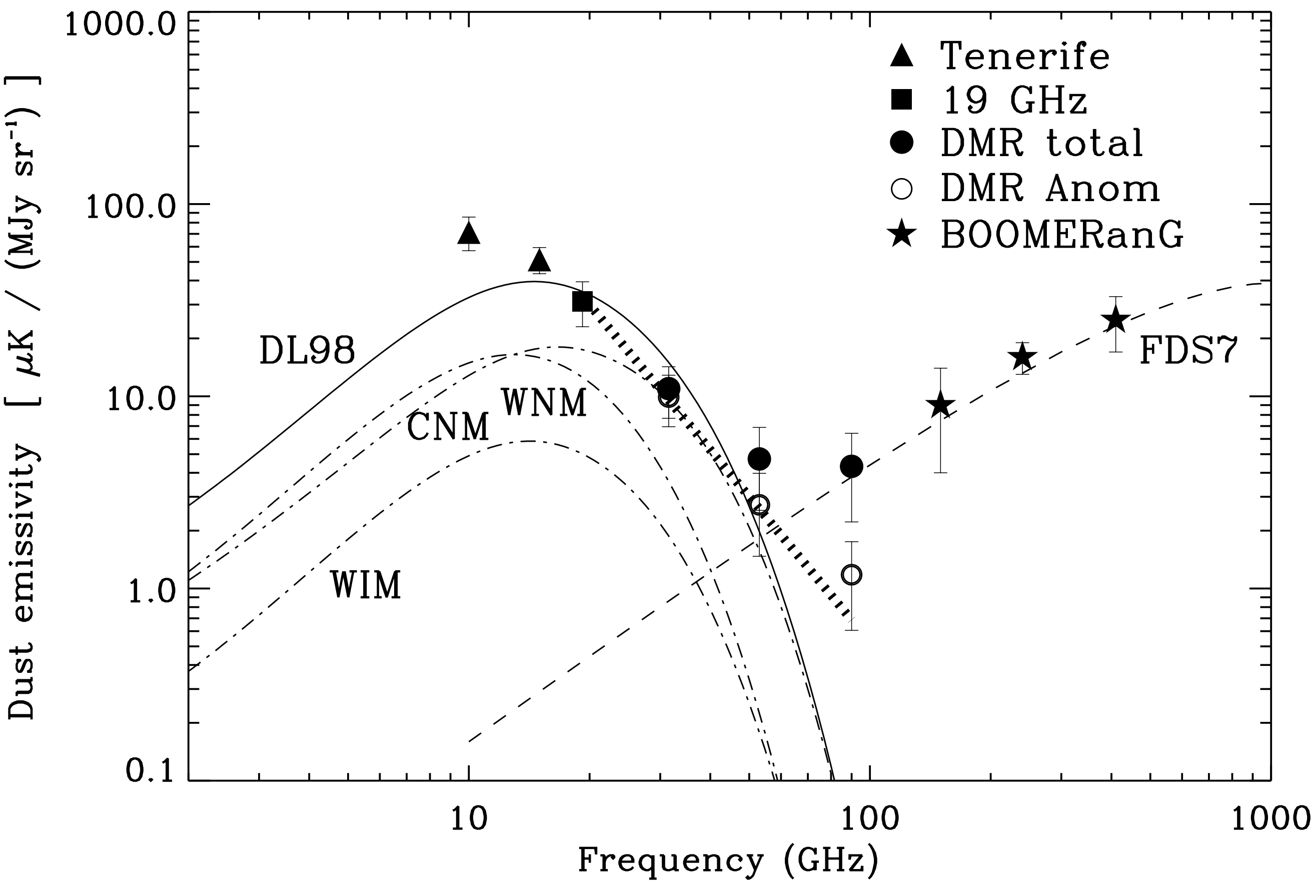

31.5 GHz
b>15
standard
b>30
$\alpha^{H\alpha}$ [μK (Rayleighs)$^{-1}$]
f_d
10
8
6
4
2
0
−2
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0



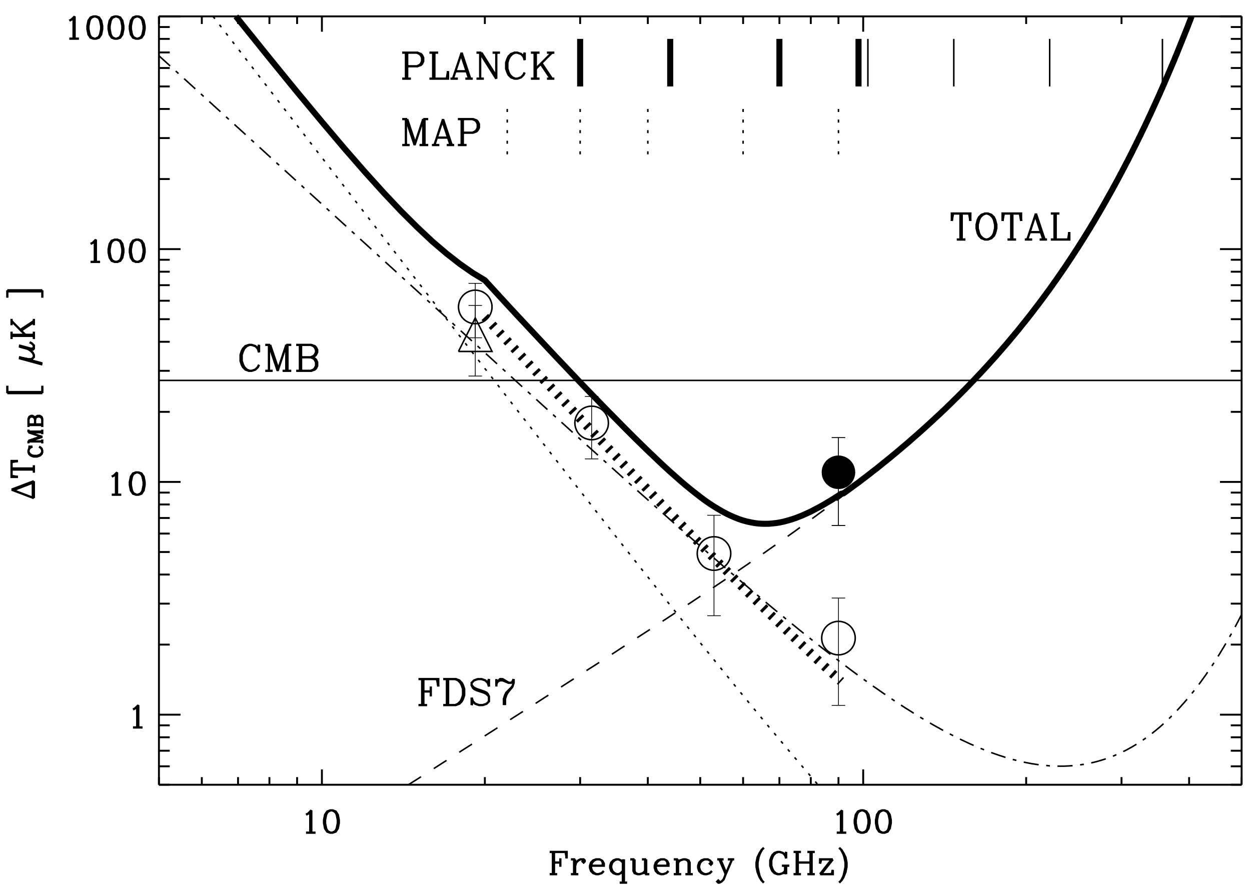
30
25
20
15
10
5
0
−5
f_d = 0.0
f_d = 0.5
f_d = 1.0
$\alpha^{\mathrm{Template}}$ [μK (Units)$^{-1}$]
b>15
cut−sky
b>30
Dust
Hα
Synch
Template



f_d = 0.0; FDS Model 7



Tenerife
19 GHz
DMR total
DMR Anom
BOOMERanG
DL98
CNM
WNM
WIM
FDS7
1000.0
100.0
10.0
1.0
0.1
10
100
1000
Frequency (GHz)
Dust emissivity [μK / (MJy sr⁻¹)]



1000
100
10
1
PLANCK
MAP
TOTAL
CMB
FDS7
ΔT_{CMB} [μK]
10
100
Frequency (GHz)